THE OHIO STATE UNIVERSITY
COLLEGE OF PUBLIC HEALTH

PUBHEHS 7382 – *Exposure Science Monitoring Techniques* II

(Hybrid Course: 3 credits for 4.5-clock hours Asynchronous Online Lectures + In-Person Labs per week x 14-week semester)

Spring Semester, 2024

Prerequisite: PUBHEHS 7380 – *Exposure Science Monitoring Techniques* I

Course Director and Instructors:

Ahmad El-Hellani, PhD (Course Director + Primary Instructor)
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Graduate Teaching Assistant (GTA):
TBN

Course Delivery Modes, Time, and Location: Hybrid course delivery via **(1)** online asynchronous distance learning lectures, viewings, and readings plus **(2)** on-campus/in-person laboratory sessions Fridays, 12:30 PM-3:30 PM at 478 Cunz Hall
Instructors' Office Hours: By appointment
TA Office Hours: By appointment

TA responsibilities: The TA assigned to the course will hold regular office hours, assist students who need help with class material, and conduct laboratory demonstrations. The TA may assist with scoring homework, presentations, quizzes, and exams; however, the professor will assign final grades. Any questions regarding grading should be directed to the professor and not the TA.

Course description and content: Environmental health science (EHS) is a multidiscipline profession focusing mainly on public (human) health issues related to food/water/beverage sanitation, and water, air, and land (soil) contamination and pollution. As a sub-discipline of EHS, Exposure Science is focused on the identification and characterization of the contact of humans (and other organisms) with contaminants in these environmental matrices and the uptake of such into the body. The Exposure Science Monitoring course will emphasize the principles and practices of human exposure sampling and analysis of contaminants in air, water, and soil, as well as analysis of biological specimens (i.e., saliva, urine, exhaled air, blood) for markers of exposure. Lectures, video viewings, readings, and laboratories will focus on including field sampling, and laboratory analytical instrumentation and methods. Accordingly, students will be introduced to both theoretical and practical aspects

via classroom lectures, laboratory demonstrations, required readings, assignments, and self-directed group projects.

An inherent goal of the course is to familiarize students with the relevance and application of sampling and analytical techniques for characterizing the type and magnitude of environmental contamination. The role of exposure monitoring in human exposure assessment of environmental agents and exposure regulation, prevention, and control will be discussed in lectures and emphasized in class/laboratory activities. The importance and application of the tools of exposure science to the public health-related disciplines of epidemiology and environmental and human health risk assessment will also be highlighted.

The content of the course necessarily reinforces the Environmental Health Science (EHS) model (Figure 1). The characterization of exposure to toxic agents is a necessary step for quantifying the risk of resulting adverse effects in human receptors. The conduct of exposure science requires a comprehensive knowledge of the nature of toxic agents, the pathways resulting in contact with human (and other biological) receptors, and the factors that mediate exposure. Exposure Science also informs the practice of risk assessment, and the development of effective policies and controls to protect individuals against environmental contaminants. Consequently, the conduct of risk assessment requires knowledge of the exposure continuum from source to receptor, and it is an integral part of the societal response to address exposures to environmental contaminants.

Course Format: During the 14-week term, the instructional sessions will consist of the approximate equivalent of 1.5 clock hours per week of asynchronous online lecture sessions plus 3.0 clock hours per week of on-campus/in-person laboratory sessions (Cunz Hall Lab 0478). In addition, there will be assignments consisting of applied case studies, discussions, problem sets/practice exercises, and technical reports. The course content will introduce, reinforce, and complement the required readings relating to the respective topics. Group course projects will be used to reinforce the principles of human exposure monitoring that are taught in the course.

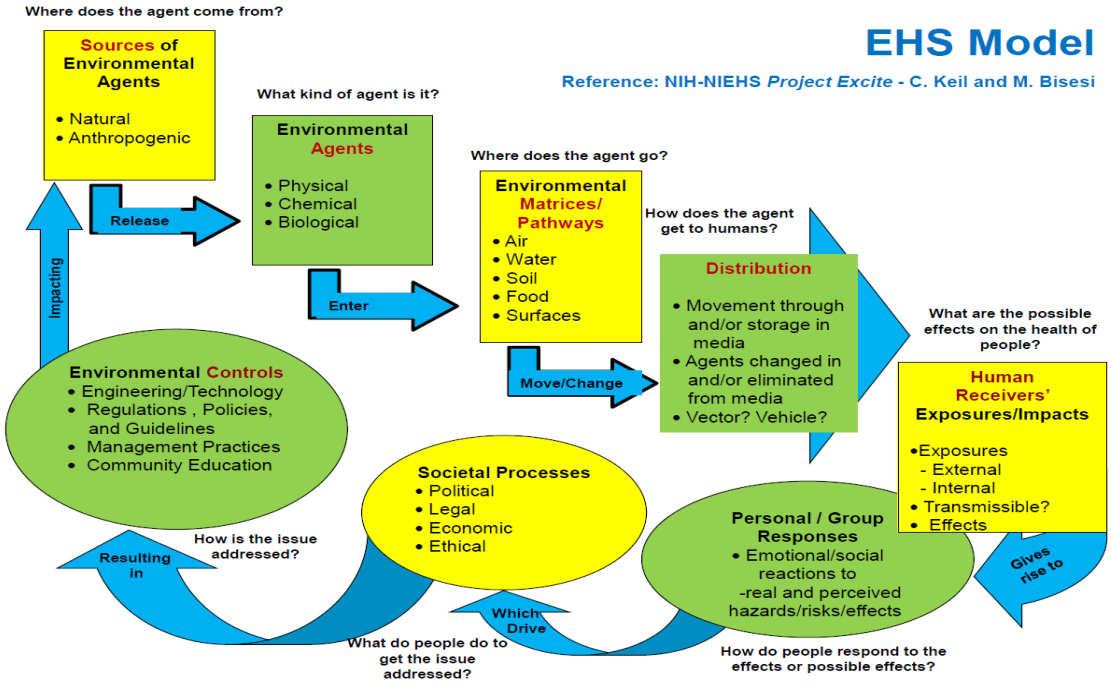

Figure 1. EHS model: components of the EHS model either inform or are informed by the risk assessment process.

Course Objectives: Upon completion of the course, students will be able to:

1. Apply the principle of the basic sciences and mathematics relative to sample collection, detection, identification, and measurement for the determination of exposure to environmental contaminants.
2. Operate applicable laboratory analytical instrumentation for the determination of contaminants in environmental media.
3. Discuss and conduct some sampling and analysis of specific environmental contaminants.
4. Describe the relationship between indicators of environmental "external exposures" and human (and animal) associated biomarkers of related "internal exposure".
5. Calculate applicable values for comparison to appropriate environmental and exposure standards and guidelines.
6. Apply information to general environmental health practice with a focus on comprehensive exposure assessment.
7. Write relevant scientific and technical reports.

Applicable MPH-EHS Specialization Competencies

Upon completion of the course, MPH degree students with a specialization in environmental health sciences should also be able to:

1. Explain the significance of the community and workplace environment to public health.
2. Outline the health threat that natural and anthropogenic contaminants in the environment can pose to population health.
8. Access state, federal, and local resources for assessing environmental and occupational health.
10. Determine the role of exposure assessment in environmental and occupational health.

Applicable MS-ES-EPH Competencies

Upon completion of the course, MS students should also be able to:

4. Conduct a research project using appropriate research methods and ethical approaches.
6. Communicate in writing and orally a research project's methods, results, limitations, conclusions, and public health relevance.
8. Apply the environmental health paradigm (i.e., EHS model) to characterizing hazardous chemicals, and biological agents relative to sources, categories, exposure matrices/pathways, distribution, human exposures, responses, societal/regulatory actions, and technological controls.
9. Work with various stakeholders and other professions to address environmental and occupational regulatory policy and human health issues and concerns proactively and reactively.

Applicable PhD-ES-EPH Competencies

Upon completion of the course, PhD students should also be able to:

4. Formulate hypotheses, plan, and conduct a research study using appropriate research methods and ethical approaches.
6. Communicate in writing and orally a research project's purpose, methods, results, limitations, conclusions, and public health relevance to both informed and lay audiences.
8. Apply the environmental health paradigm (i.e., EHS model) to characterizing hazardous chemicals, and biological agents relative to sources, categories, exposure matrices/pathways, distribution, human exposures, responses, societal/regulatory actions, and technological controls.
9. Work with various stakeholders and other professions to address environmental and occupational regulatory policy and human health issues and concerns proactively and reactively.

Text/Readings: Readings are listed in the course schedule and will be posted on Carmen (https://carmen.osu.edu/#).

Mandatory Websites: Applicable and useful online resources on the internet include, but are not limited to, the following:

- OSHA: https://www.osha.gov/otm/table-of-contents
- CDC/NIOSH: http://www.cdc.gov/niosh/docs/2003-154/
- CDC: http://www.cdc.gov/Environmental/
  http://www.cdc.gov/labstandards/
  http://www.cdc.gov/nceh//

Note: Links to mandatory readings from other useful references are listed in the syllabus

Optional Reading:

- *Occupational Environment:* ***Its Evaluation, Control, and Management*** (AIHA 2011 3rd Edition)
- ***Bisesi & Kohn's Industrial Hygiene Evaluation Methods*** (Bisesi 2003 2nd Edition) Taylor & Francis Publishers – available free online via OSU: https://ebookcentral-proquest-com.proxy.lib.ohio-state.edu/lib/ohiostate-ebooks/detail.action?docID=198991
- ***Exposure Assessment in Environmental Epidemiology*** (Ed by Mark J. Nieuwenhuijsen 2015 2nd Edition)

Grading: Grades will be assigned for class participation, problem sets, reports, "mini" homework, course projects, and documentation of learning materials as follows:

Activity	Points Total (100%)
Attendance/Participation	5
Mini Assignment	5
Problem Sets 1 thru 4 (reviewed and corrected together)	20
Technical Lab Reports	30
Self-Directed Project Report	15
Project Presentation	10
Portfolio	15

Activities will be graded against the following 10-point scale:

Score	Criteria
100	Superb work. . . thorough, complete, and correct; beyond expectation. This is a rare and exceptional grade.
90	Excellent . . . thorough, complete, and correct with only very minor errors or omissions.
80	Very good . . . adequately covers the major facets of the lab but lacks rigor and completeness with respect to details.
70	Good. . . adequately covers most of the major facets of the lab but lacks rigor and completeness with respect to details.
60	Adequate . . . covers correctly and completely some of the lab content/principles but with some major omissions. Report is incomplete and carelessly prepared
<60	Poor. . . incomplete and incorrect.

Final grades will be assigned according to the **OSU Standard Grade Scheme.**

Grade	Percentage
A	100-93
A-	92.9-90
B+	89.9-87
B	86.9-83
B-	82.9-80
C+	79.9-77
C	76.9-73
C-	72.9-70
D+	69.9-67
D	66.9-60
E	<60

Assignments: Students will be given one **mini-assignment** and four **problem sets** based on the materials covered during the course sessions. The mini-assignment will be discussed in class, while the problem sets will be reviewed, and students will be allowed to submit corrections. Students will also be required to submit 12 technical lab reports. Guidance about the format of the report will be provided by the instructor.

Each student will be tasked with assembling a **portfolio** of course-relevant materials for each session and will be expected to turn them in at the end of the semester on the due date stated in the course outline. Instruction about the materials to compile will be provided by the instructor on the first day of class.

Students will work in groups of two or three to conduct an exposure assessment project with options and guidance provided by the professor. The project will be **submitted as a report to the instructor/TA and presented to the class** at the end of the course at the due time specified in the course schedule. Guidance about the format of the report and presentation will be provided by the instructor. Each member of the group will be expected to contribute equally to conducting the project, writing the report, and putting together and delivering the presentation. Each member of the group may earn different scores on the group project assignments as follows: 90% of the scores for the group project report and presentation will be awarded to all group members based on the overall quality of the work, while 10% of the scores will be awarded to each member based on the level of contribution made to the project. Guidance about the format of the report and presentation will be provided by the instructor.

Carmen Canvas: The syllabus, class schedule, class readings (or links to class materials), and lecture slides will be posted on the Carmen/Canvas site for the course.

Attendance Policy: To achieve this course's objectives and become a public health professional, attendance is expected in all scheduled in-person and synchronous online classes. If a student has an *extenuating* circumstance (e.g., unforeseen medical issues, death in the family, etc.) that prevents them from attending class, they should notify the instructor *before* class.

Additional Course Policies: Please note that students are discouraged from using mobile devices while in class and that the use of computers is only allowed if such use is related to class activities.

Health and Safety Requirements: All students, faculty, and staff are required to comply with and stay up to date on all university safety and health guidance (https://safeandhealthy.osu.edu). Non-compliance will first be warned, and disciplinary actions will be taken for repeated offenses.

Office of Student Life: Disability Services: Any student who feels may need an accommodation based on the impact of a disability should contact me privately to discuss your specific needs. Please contact the Office of Student Life: Disability Services at 614-292-3307 in Room 098 Baker Hall to coordinate reasonable accommodations for students with documented disabilities (http://slds.osu.edu/).

Student Support: A recent American College Health Survey found stress, sleep problems, anxiety, depression, interpersonal concerns, death of a significant other, and alcohol use among the top ten health impediments to academic performance. Students experiencing personal problems or situational crises during the semester are encouraged to contact OSU Counseling and Consultation Services (292-5766; http://ccs.osu.edu) for assistance, support, and advocacy. This service is free to students and is confidential.

Mental Health Services: As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614-292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available 24/7 by dialing 988 to reach the Suicide and Crisis Lifeline.

Academic Integrity: Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University, the College of Public Health, and the Committee on Academic Misconduct (COAM) expect that all students have read and understood the University's *Code of Student Conduct* and the School's *Student Handbook* and that all students will complete all academic and scholarly assignments with fairness and honesty. The *Code of Student Conduct* and other information on academic integrity and academic misconduct can be found on the COAM web pages (http://oaa.osu.edu/coam/home.html). Students must recognize that failure to follow the rules and guidelines established in the University's *Code of Student Conduct*, the *Student Handbook*, and the syllabi for their courses may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: *"Any activity that tends to compromise the academic integrity of the University or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying another student's work, and possession of unauthorized materials during an examination. Please note that the use of material from the Internet without appropriate acknowledgment and complete citation is plagiarism just as it would be if the source were printed material. Further examples are found in the Student Handbook. Ignorance of the Code of Student Conduct and the Student Handbook is never considered an "excuse" for academic misconduct.*

If the course directors/professors suspect a student of academic misconduct in a course, I am obligated by University Rules to report these suspicions to the University's Committee on Academic Misconduct. If COAM determines that the student has violated the University's *Code of Student Conduct* (i.e., committed academic

misconduct), the sanctions for the misconduct could include a failing grade in the course and suspension or dismissal from the University. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact the course directors Dr. El-Hellani and Dr. Adetona.

Course 2 Modules/Topics/Assignments/Schedule – Spring Semester 2024
3-credits (but due to Lab = 4.5 clock hours per week)

Week No.	Session Dates (Lecturer)	Topics	Aligned Course Learning Objective (s)	Aligned Specialization Competencies	Readings/Viewings/ Other Assignments	Student Evaluation Activity for Assessment*
1	(Dr. El Hellani) Asynchronous Online Session	• Introduction to Environmental Analytical Chemistry	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• NIOSH Manual of Analytical Methods. "Quality Assurance" http://www.cdc.gov/niosh/docs/2003-154/pdfs/chapter-c.pdf • Analytical Chemistry 2.0 by David Harvey (Open Access) – Chapters 1 & 5 https://sites.google.com/depauw.edu/dth/analytical-curriculum-projects/ac2-0 **Mini assignment assigned**: Each student will prepare a 3-slide presentation to introduce an analytical instrument to the class at the beginning of the next in-person lab session. The instructor will assign the instruments to the students in week 1. **All students are required to finish any pending lab safety training**	Mini assignment; Portfolio; Case study project
	(Dr. El Hellani) On-Campus In-Person Lab Session (01/12/24)	• Discussion of the course flow, the final project, and the portfolio requested at the end of the course • Lab safety and good practices • Introduction to the analytical lab	1, 2, 4, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• National Research Council Recommendations Concerning Chemical Hygiene in Laboratories https://www.osha.gov/laws-regs/regulations/standardnumber/1910/1910.1450AppA#:~:text=The%20OSHA%20Laboratory%20standard%20defines,chemicals%20used%20in%20that%20particular • Analytical Chemistry 2.0 by David Harvey (Open Access) – Chapter 1 & 5 https://sites.google.com/depauw.edu/dth/analytical-curriculum-projects/ac2-0 **In-person lab meeting:** 1. **Introducing the course** 2. Documentation of safety training records for all students 3. Introduce the chemical hygiene plan and other safety requirements 4. Review lab safety and good practices (e.g., PPE, responsible lab behavior, keeping analytical instruments safe and functional, etc.) 5. Lab introduction includes examples of each type of instrumentation discussed in the pre-class online lecture 6. Discuss technical reports and portfolio templates **Mini assignment assigned: 3-min presentation by each student** **Assemble applicable portfolio content**	Mini assignment; Portfolio; Problem set; Technical report to demonstrate the role of analytical lab in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario

Week No.	Session Dates (Lecturer)	Topics	Aligned Course Learning Objective (s)	Aligned Specialization Competencies	Readings/Viewings/ Other Assignments	Student Evaluation Activity for Assessment*
2	(Dr. El Hellani) Asynchronous Online Session	• Introduction to Gas Chromatography	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Gas Chromatography: What You Need to Know About Its Principles, Types, and Working https://lab-training.com/gas-chromatography/ • Analytical Chemistry 2.0 by David Harvey (Open Access) – Chapters 5 & 12 https://sites.google.com/depauw.edu/dth/analytical-curriculum-projects/ac2-0 **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Technical report to demonstrate the role of gas chromatography in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Dr. El Hellani) On-Campus In-Person Lab Session (01/19/24)	• Demonstration of two GCs • GC Method and sample sequence • Basic Lab techniques (e.g., pipetting) • Analysis of multi-analyte sample	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Gas Chromatography: What You Need to Know About Its Principles, Types, and Working https://lab-training.com/gas-chromatography/ • Analytical Chemistry 2.0 by David Harvey (Open Access) – Chapters 5 & 12 https://sites.google.com/depauw.edu/dth/analytical-curriculum-projects/ac2-0 **In-person lab meeting:** 1. Discussion of GC method upload and sequence input 2. Preparation of multi-analyte sample at different concentrations (pipetting training) 3. Injection of samples into GCMS 4. Qualitative and quantitative data analysis **Mini-Assignment due: In-person presentation and discussion** **GC Analysis Report assigned** **Assemble applicable portfolio content**	Portfolio; Technical report to demonstrate the role of gas chromatography in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
3	(Dr. El Hellani) Asynchronous Online Session	• Sources of VOC exposure (e.g., environmental, occupational, etc.) • Risk of VOC exposure (short and long-term)	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Volatile Organic Compounds Factsheet https://odh.ohio.gov/know-our-programs/health-assessment-section/media/voc-factsheet **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Dr. El Hellani)	• Smoke sample generation	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10	• Volatile Organic Compounds Factsheet	Portfolio; Problem set; Technical

	On-Campus In-Person Lab Session (01/26/24)	• Gas phase sample collection on gas sampling cartridge for VOC analysis • Particle collection in the same setup for SVOC analysis		MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	https://odh.ohio.gov/know-our-programs/health-assessment-section/media/voc-factsheet • Volatile organic compounds: sampling methods and their worldwide profile in ambient air https://pubmed.ncbi.nlm.nih.gov/17171267/ **In-person lab meeting:** 1. Sample generation on smoking machine 2. Tandem sampling of particle and gas phase toxicants 3. Repeatability of sampling 4. Sample handling and storage **GC Analysis Report due** **Smoke Sampling Report assigned** **Problem Set 1 assigned** **Assemble applicable portfolio content**	report to estimate VOCs in environmental and occupational exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
4	(Dr. El Hellani) Asynchronous Online Session	• Exposure to semi-volatiles • Analysis of semi-volatiles	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• A review of semi-volatile organic compounds (SVOCs) in the indoor environment: occurrence in consumer products, indoor air and dust https://www.sciencedirect.com/science/article/pii/S0045653518303734 **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Dr. El Hellani) On-Campus In-Person Lab Session (02/02/24)	• Semi-volatile analysis (e.g., nicotine in ½ filter) of samples collected in previous week • Cal curve, recovery, LOD, and LOQ of GC method	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• A review of semi-volatile organic compounds (SVOCs) in the indoor environment: occurrence in consumer products, indoor air and dust https://www.sciencedirect.com/science/article/pii/S0045653518303734 • Sampling and Analysis of Semi-volatile Organic Compounds (SVOCs) in Indoor Environments https://link.springer.com/referenceworkentry/10.1007/978-981-16-7680-2_16 **In-person lab meeting:** 1. Sample preparation and analytes extraction 2. Preparation of standard stock solutions (e.g., nicotine) 3. Preparation of 5 dilutions to build a calibration curve 4. Quality Assurance and Quality Control 5. Sample injection in GC by students under supervision of the instructor **Smoke Sampling Report due** **Problem Set 1 due** **SVOC Report assigned** **Assemble applicable portfolio content**	Portfolio; Technical report to estimate semi-volatiles in environmental and occupational exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario

5	(Dr. El Hellani) Asynchronous Online Session	• Introduction to Liquid Chromatography	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• HPLC Basics https://www.youtube.com/watch?v=ZN7euA1fS4Y • Analytical Chemistry 2.0 by David Harvey (Open Access) – Chapters 5 & 12 https://sites.google.com/depauw.edu/dth/analytical-curriculum-projects/ac2-0 **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Technical report to demonstrate the role of liquid chromatography in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Dr. El Hellani) On-Campus In-Person Lab Session (02/09/24)	• Demonstration of LC tandem UV and MS detectors • Calibration of LC • Analysis of VOCs (e.g., carbonyls) in samples collected in week 3.	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• HPLC Basics https://www.thermofisher.com/us/en/home/industrial/chromatography/chromatography-learning-center/liquid-chromatography-information/hplc-basics.html#menu4 • Analytical Chemistry 2.0 by David Harvey (Open Access) – Chapters 5 & 12 https://sites.google.com/depauw.edu/dth/analytical-curriculum-projects/ac2-0 **In-person lab meeting:** 1. Preparation of standard stock solutions (e.g., carbonyls) 2. Preparation of 5 dilutions to build a calibration curve 3. Quality Assurance and Quality Control 4. Demonstration of running analysis on LC **SVOC Report due** **LC VOC Analysis Report assigned** • **Assemble applicable portfolio content**	Portfolio; Problem set; Technical report to demonstrate the role of liquid chromatography in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
6	(Dr. Adetona) Asynchronous Online Session	• Surface contamination and skin exposure • Surface sampling	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Dermal exposure to chemicals in the workplace: just how important is skin absorption? https://oem.bmj.com/content/61/4/376 **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Technical report to understand the importance of surface sampling in assessing environmental and occupational exposure; Case study project to enable the application of tools/methods learned in the lab

						to a real-life exposure scenario
	(Drs. Adetona and El Hellani) On-Campus In-Person Lab Session (02/16/24)	• Surface sample collection (simulated in lab)	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Dermal exposure to chemicals in the workplace: just how important is skin absorption? https://oem.bmj.com/content/61/4/376 • Surface Sampling Process https://www.youtube.com/watch?v=__OWBeICXH4 • Surface Sampling Guidance, Considerations, and Methods in Occupational Hygiene https://www.cdc.gov/niosh/nmam/pdf/nmam_chap_sg-508.pdf **In-person lab meeting:** 1. Preparation of sampling kit 2. Sampling (e.g., contaminated lab bench) 3. Labeling and storage of samples for next week **Problem Set 2 (Mini quiz)** **LC VOC Analysis Report due** **Surface Sampling Report assigned** **Assemble applicable portfolio content**	Portfolio; Problem set; Technical report to understand the importance of surface sampling in assessing environmental and occupational exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario; exam
7	(Dr. El Hellani) Asynchronous Online Session	• Solventless extraction methods: principles and applications (i.e., headspace, SPME, and sorbent tubes)	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Dispersive Liquid-Liquid Microextraction https://www.hindawi.com/journals/jchem/2016/4040165/ • Micro-extraction Sampling https://www.future-science.com/doi/10.4155/bio.12.139 **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Technical report to understand the importance of headspace analysis in assessing environmental and occupational exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Dr. El Hellani) On-Campus In-Person Lab Session (02/23/24)	• Demonstration of headspace analysis • Analysis of surface samples collected in previous week	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Quantitation of Nicotine using headspace GCMS https://pubs.acs.org/doi/10.1021/acsomega.0c00384 **In-person lab meeting:** 1. Sample preparation for headspace GC analysis 2. Preparation of standard stock solutions	Portfolio; Problem set; Technical report to understand the importance of headspace analysis

					3. Preparation of 5 dilutions to build a calibration curve 4. Quality Assurance and Quality Control 5. Sample injection in GC by students under supervision of the instructor **Surface Sampling Report due** **Headspace Analysis Report assigned** **Assemble applicable portfolio content**	in assessing environmental and occupational exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario; exam
8	(Dr. Weir) Asynchronous Online Session	• Wastewater monitoring • Analysis of toxicants in wastewater	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Understanding Antibiotic Resistance in Water: A One Health Approach https://www.cdc.gov/onehealth/in-action/understanding-antibiotic-resistance-in-water.html • The influence of antibiotics on wastewater treatment processes and the development of antibiotic-resistant bacteria https://iwaponline.com/wst/article/77/9/2320/38640/The-influence-of-antibiotics-on-wastewater **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Technical report to understand the importance of monitoring antibiotics in wastewater; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Drs. Weir & El Hellani) On-Campus In-Person Lab Session (03/01/24)	• Analysis of nicotine in hookah water bowl as a demonstration	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Spatial distribution and risk assessment of certain antibiotics in 51 urban wastewater treatment plants in the transition zone between North and South China https://www.sciencedirect.com/science/article/abs/pii/S0304389422010974 • Analysis of wastewater and nicotine use in the population https://www.sciencedirect.com/science/article/pii/S004313542301480X?ref=pdf_download&fr=RR-2&rr=845fd0a7eedf6199 **In-person lab meeting:** 1. Sample preparation for LC analysis 2. Preparation of standard stock solutions 3. Preparation of 5 dilutions to build a calibration curve 4. Quality Assurance and Quality Control 5. Sample injection in LC by students under supervision of the instructor **Headspace Analysis Report due** **Problem Set 3 assigned** **Toxicants in Wastewater Analysis Report assigned**	Portfolio; Problem set; Technical report to understand the importance of monitoring antibiotics in wastewater; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario

					• **Assemble applicable portfolio content**	
9	(Dr. Knobloch) Asynchronous Online Session	• Overview of molecular biology techniques used in environmental and occupational exposure assessment	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Overview on Recent Advances in Molecular Biology Techniques https://www.longdom.org/open-access/overview-on-recent-advances-in-molecular-biology-techniques-91931.html • Polymerase Chain Reaction (PCR) https://www.ncbi.nlm.nih.gov/probe/docs/techpcr/#:~:text=PCR%20(Polymerase%20Chain%20Reaction),to%20the%20offered%20template%20strand. **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Technical report to demonstrate the role of molecular biology techniques in assessing environmental and occupational exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Drs. Knobloch & El Hellani) On-Campus In-Person Lab Session (03/08/24)	• Analysis of microorganisms in samples	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Application of quantitative PCR for the detection of microorganisms in water https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7079929/ • In vitro Cytotoxicity Assessments of Environmental Samples https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8879481/#:~:text=The%20characterization%20of%20in%20vitro,exposure%20assessment%20studies%20%5B8%5D. **In-person lab meeting:** 1. Smoke sample collection in cell culture 2. Sample preparation and cytotoxicity assays 3. Sample analysis by students under the supervision of the instructor **Problem Set 3 due** **Toxicants in Wastewater Analysis Report due** **Molecular Biology Techniques Report assigned** • **Assemble applicable portfolio content**	Portfolio; Problem set; Technical report to demonstrate the role of molecular biology techniques in assessing environmental and occupational exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
SPRING BREAK 03/11-15/24						
10	(Dr. El Hellani) Asynchronous Online Session	• Targeted and non-targeted environmental analysis	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9	Evidence of complementarity between targeted and non-targeted analysis based on liquid and gas-phase chromatography coupled to mass spectrometry for screening halogenated persistent organic pollutants in environmental matrices https://www.sciencedirect.com/science/article/abs/pii/S0045653522001047	Portfolio; Problem set; Technical report to understand the importance of

		• Complimentary analysis using different analytical methods		PhD-ES-EPH – 4, 6, 8, 9	**Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	complimentary analysis in assessing real-life exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Dr. El Hellani) On-Campus In-Person Lab Session (03/22/24)	• Analysis of nicotine in ½ filters collected in week 3 on LC and compare to GC results	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Liquid Chromatography's Complementary Role to Gas Chromatography in Cannabis Testing https://www.chromatographyonline.com/view/liquid-chromatography-s-complementary-role-gas-chromatography-cannabis-testing **In-person lab meeting:** 1. Sample preparation and analytes extraction 2. Preparation of standard stock solutions (e.g., nicotine) 3. Preparation of 5 dilutions to build a calibration curve 4. Quality Assurance and Quality Control 5. Sample injection in LC by students under supervision of the instructor **Molecular Biology Techniques Report due** **Comprehensive Analysis Report assigned** • **Assemble applicable portfolio content**	Portfolio; Problem set; Technical report to understand the importance of complimentary analysis in assessing real-life exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
11	(Dr. El Hellani) Asynchronous Online Session	• Biomonitoring • Biomarkers of exposure • Biomarkers of health effects	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Biomonitoring: Population Exposures https://www.cdc.gov/nceh/tracking/topics/Biomonitoring.htm#:~:text=Scientists%20at%20CDC%20determine%20which,This%20is%20called%20biomonitoring. • Human Biomonitoring of Environmental Chemicals https://www.cdc.gov/biomonitoring/pdf/as_article_biomonitoring.pdf • Biomarkers of Environmental Toxicants: Exposure and Biological Effects https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7356252/ **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Technical report to understand the importance of biomonitoring in assessing real-life exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Dr. El Hellani)	• Analysis of saliva samples for cotinine analysis on LC	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10	• Biomarkers of exposure to new and emerging tobacco delivery products	Portfolio; Technical report to understand the

	On-Campus In-Person Lab Session (03/29/24)			MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	https://journals.physiology.org/doi/full/10.1152/ajplung.00343.2016#:~:text=Cotinine%20is%20the%20major%20proximate,used%20biomarker%20of%20nicotine%20exposure. **In-person lab meeting:** 1. Sample collection and spiking 2. Sample preparation and analytes extraction 3. Preparation of standard stock solutions (e.g., cotinine) 4. Preparation of 5 dilutions to build a calibration curve 5. Quality Assurance and Quality Control 6. Sample injection in LC by students under supervision of the instructor **Complimentary Analysis Report due** **Biomonitoring Report assigned** • **Assemble applicable portfolio content**	importance of biomonitoring in assessing real-life exposure; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
12	(Dr. Basta) Asynchronous Online Session	• Introduction to metal analysis on Inductively Coupled Plasma Spectroscopy – Mass Spectrometry	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• An Introduction to the Fundamentals of Inductively Coupled Plasma – Mass Spectrometry (ICP-MS) https://www.agilent.com/en/product/atomic-spectroscopy/inductively-coupled-plasma-mass-spectrometry-icp-ms/what-is-icp-ms-icp-ms-faqs **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Technical report to demonstrate the role of ICP-MS in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Drs. Basta & El Hellani) On-Campus In-Person Lab Session (04/05/24)	• Demonstration on ICP-MS in Dr. Basta's lab	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Key Steps to Create a Sample Preparation Strategy for Inductively Coupled Plasma (ICP) or ICP–Mass Spectrometry (ICP-MS) Analysis https://www.spectroscopyonline.com/view/key-steps-to-create-a-sample-preparation-strategy-for-inductively-coupled-plasma-icp-or-icp-mass-spectrometry-icp-ms-analysis?utm_medium=paid&utm_source=google&utm_campaign=audience_development_2023&utm_term=ICP&utm_content=search_ • NIOSH Manual of Analytical Methods. "Elements by ICP (Hot Block/HCl/HNO_3 Digestion)" https://www.cdc.gov/niosh/docs/2003-154/pdfs/7303.pdf **In-person lab meeting:** 1. Sample collection 2. Sample preparation and analytes extraction 3. Preparation of standard stock solutions 4. Preparation of 5 dilutions to build a calibration curve	Portfolio; Problem set; Technical report to demonstrate the role of ICP-MS in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario

					5. Quality Assurance and Quality Control 6. Demonstration of running analysis on ICP-MS by instructor **Biomonitoring Report due** **ICP Metal Analysis Report assigned** **Problem Set 4 assigned** • **Assemble applicable portfolio content**	
13	(Dr. El Hellani) Asynchronous Online Session	• Introduction to spectrophotometry	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Analytical Chemistry 2.0 by David Harvey (Open Access) – Chapters 5 & 10 https://sites.google.com/depauw.edu/dth/analytical-curriculum-projects/ac2-0 • Spectrophotometry https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Kinetics/02%3A_Reaction_Rates/2.01%3A_Experimental_Determination_of_Kinetics/2.1.05%3A_Spectrophotometry **Pre-Class Online Lecture (listen to prior to in-person lab meeting)**	Portfolio; Problem set; Technical report to demonstrate the role of spectrophotometry in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario
	(Dr. El Hellani) On-Campus In-Person Lab Session (04/12/24)	• Fluorescence analysis (e.g., reactive oxygen species from smoke samples) • Demonstration of microplate reader	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	• Spectrophotometric determination of nickel (II) with 2-aminoacetophenone Isonicotinoylhydrazone https://www.scholarsresearchlibrary.com/articles/spectrophotometric-determination-of-nickel-ii-with-2aminoacetophenoneisonicotinoylhydrazone.pdf • Simultaneous determination of DTPA, EDTA, and NTA by UV-visible spectrometry and HPLC https://pubmed.ncbi.nlm.nih.gov/15971044/ **In-person lab meeting:** 1. Sample collection 2. Sample preparation and analytes extraction 3. Preparation of standard stock solutions (e.g, H_2O_2) 4. Preparation of 5 dilutions to build a calibration curve 5. Quality Assurance and Quality Control 6. Sample analysis on microplate reader by students under supervision of the instructor **ICP Metal Analysis Report due** **Spectrophotometry Analysis Report assigned** **Problem Set 4 due** • **Assemble applicable portfolio content**	Portfolio; Problem set; Technical report to demonstrate the role of spectrophotometry in generating exposure data; Case study project to enable the application of tools/methods learned in the lab to a real-life exposure scenario

14	(Dr. El Hellani) In-person Session (04/19/24)	• Real-life exposure projects	1, 2, 3, 4, 5, 6	MPH EHS – 1, 2, 8, 10 MS-ES-EPH – 4, 6, 8, 9 PhD-ES-EPH – 4, 6, 8, 9	**Project Presentations due (Reports are due in 1-week after presentations)** **Spectrophotometry Analysis Report due** • **Assemble applicable portfolio content**	Portfolio; Project presentation;

*** Please see the grading section of the syllabus for evaluation modes, rubric, and assigned points**